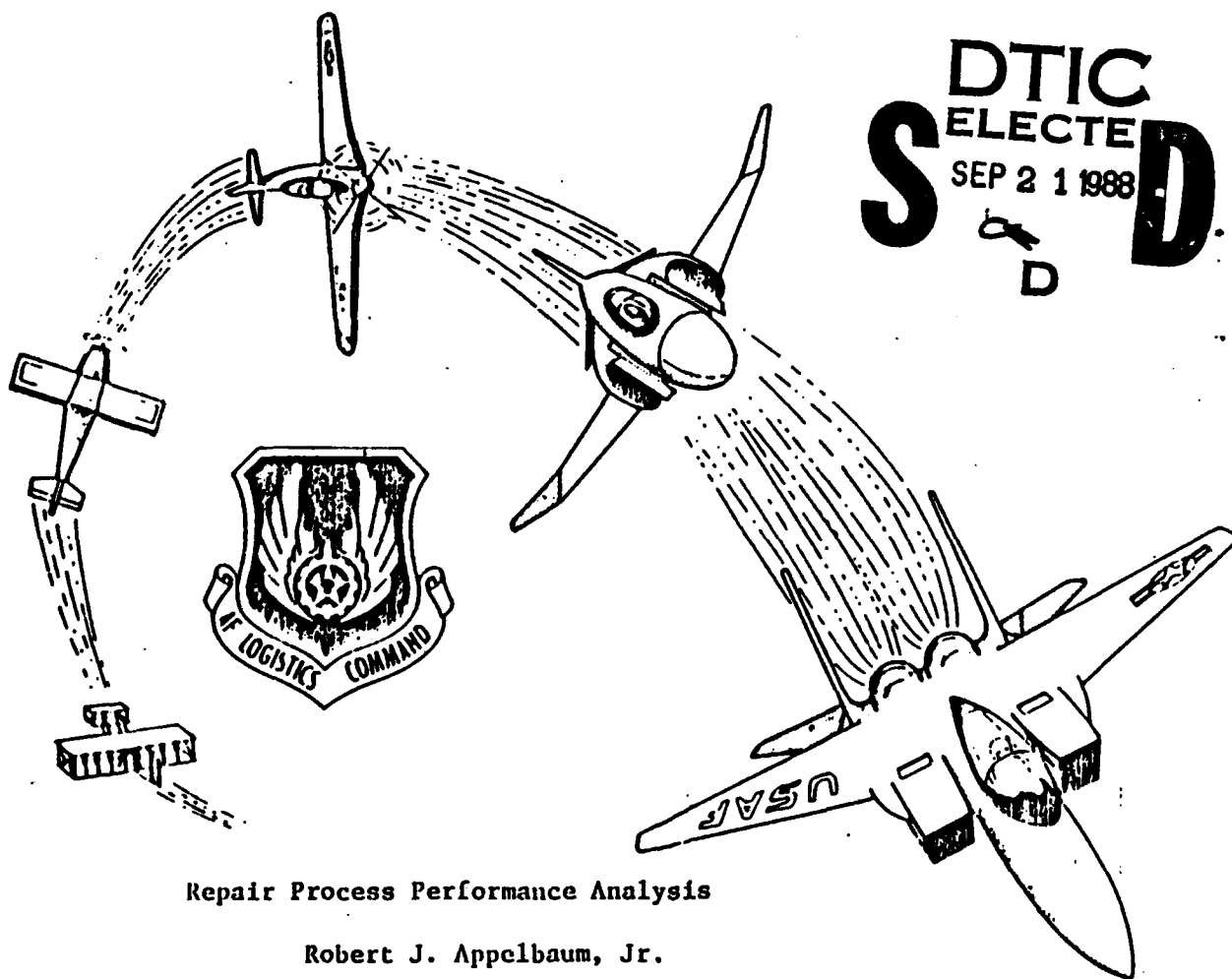AD-A198 834

AIR FORCE LOGISTICS COMMAND

MATERIEL ANALYSIS

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Repair Process Performance Analysis

Robert J. Appelbaum, Jr.

HQ AFLC/MMMAA

May 1988

FINAL rpt.,

88 6 28 188

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS AIR FORCE LOGISTICS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-5001

REPLY TO
ATTN OF: MMM

0 6 JUN 1988

SUBJECT: Repair Process Performance Analysis

TO: SEE DISTRIBUTION

1. The Air Force currently uses a variety of techniques for measuring the performance of the depot level exchangeable repair process. These methods do not determine whether the Air Force Logistics Command (AFLC) is repairing the right items nor do they determine if we are repairing the right quantity of items.

2. We have identified a standard method for the measurement of depot level repair performance. This report (see Attachment 3) documents the development of a system that will provide a way to assess the performance of exchangeable repair at many different levels (by Air Logistics Center—ALC—unit, branch, division, or by weapon system). The system will provide a way to do detailed repair analysis and identify repair process bottlenecks. We recommend the system be used by all levels of management. The inventory management and production management specialists can use it to aid in prioritization and repair analysis. Workload schedulers can use it to identify why items are not being repaired. System Program Managers and major commands (MAJCOMs) can use it to measure repair performance for their weapon systems. Headquarters and ALC managers can assess the performance of their repair process.

3. Our conclusions and recommendations are provided in Attachment 1. Point of contact is Mr Bob Appelbaum, HQ AFLC/MMMAA, AUTOVON 787-5269.

FOR THE COMMANDER

MARVIN L. DAVIS, Colonel, USAF
Director, Materiel Requirements
  and Financial Management
DCS/Materiel Management

2 Atch
1. Conclusions and Recommendations
2. Final Report

cc: LMSC/SMW

UNITED STATES AIR FORCE

SEPTEMBER 18, 1947

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Currently, there is no consistent, accepted method for measuring the overall performance of the depot level exchangeable repair process.

2. The current system of measuring the various parts of the performance of the depot level exchangeable repair process does not meet our criteria for a successful performance measurement system.

3. The New Air Force Critical Item Program categorizes items as critical, potential critical, and problem based on Air Force-wide accepted criteria, which identifies an item's impact on peacetime and wartime weapon system availability.

4. The proposed Repair Process Performance Analysis system:

    a. Identifies repair performance by category of items; critical, potential critical, problem, and non-problem.

    b. Compares the actual repair performance to the planned repair (negotiation quantity) and the repair requirement.

    c. Identifies process bottlenecks so that solutions can be found.

    d. Measures the performance of the overall exchangeable repair process.

    e. Provides the necessary data at the execution level to ensure support actions are consistent with performance goals.

5. The WSMIS system has the data base and the programming capability to develop the performance analysis system.

RECOMMENDATIONS

1. Develop, in the WSMIS/GWAM module, the Repair Process Performance Analysis system. (OPR: LMSC/SMWW OCR: HQ AFLC/MMM)

2. Use the Repair Process Performance Analysis system to measure the performance of the depot level exchangeable repair process.
(OPR: HQ AFLC/MM/MA)

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HQ AFLC/MA/MAP/MAW
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ABSTRACT

The current system for measuring the performance of the depot level exchangeable repair process is an amalgamation of different measures that does no give a complete picture of the true depot performance. In our analysis, we propose a system which will yield this complete picture and provide information necessary to do detailed repair analysis.

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the author.

EXECUTIVE SUMMARY

In this report we examined the current method for assessing the performance of the depot level exchangeable repair process. As a result of our analysis, we propose the development of a new system for measuring this performance.

The system we propose is a series of five data "screens". Three screens provide item level data for repair prioritization execution and detailed repair analysis purposes. Two screens aggregate important portions of the item level data and portray it by unit, section, division, Air Logistics Center, Air Force Logistics Command, or by weapon system.

The author

As a result of this development effort, we recommend changes to policy effecting the way AFLC measures depot level repair performance. Keywords: Air Force Logistic Command, (CP)

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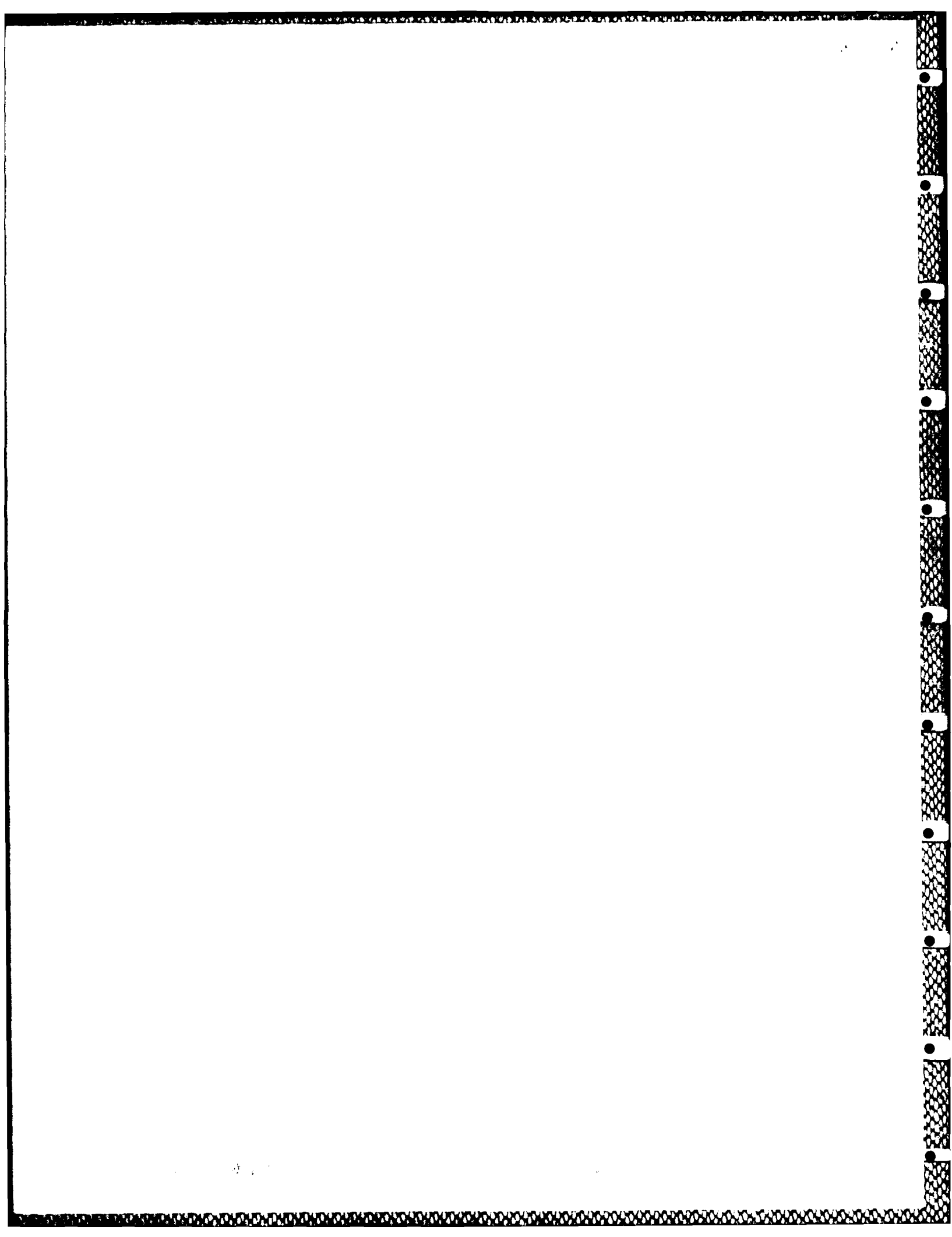
CHAPTER 1
THE PROBLEM

BACKGROUND

The Headquarters Air Force Logistics Command (HQ AFLC) Rivet Repair Steering Committee tasked us to develop a way to assess the performance of the depot level exchangeable repair process. Currently, mangers use many methods in an attempt to determine the how well the depot is performing it's mission. These methods include measuring back orders, the dollar value of awaiting parts, shop flow times and repair cycle times. None of these methods are able to determine if we are repairing the right items or if we are repairing them in the right quantities. In addition, current methods do not identify repair process bottlenecks.

PROBLEM STATEMENT

Currently, there is no good way to assess the performance of the depot level exchangeable repair process. AFLC cannot tell if they are repairing the "right" items (i.e., the items that contribute the most to peacetime aircraft availability and wartime capability) or if they are repairing the right quantity of items. In addition, current systems do not provide the necessary information at the execution level so that actions are consistent with aircraft availability driven performance goals. The current system does not identify repair process bottlenecks to ensure limited resources are applied to the right areas.

OBJECTIVES

1. Develop a method for assessing the performance of the depot level exchangeable repair process.

2. Develop a method for identifying repair process bottlenecks.

3. Provide capability to do detailed repair analysis by item or by category of item.

4. Provide incentive to the Item Management and Production Management communities to drive the right items in the right quantities to repair.

5. Recommend policy and procedures to use the system developed.

CHAPTER 2
THE ANALYSIS

<u>OVERVIEW</u>

We document our analysis in four sections. Section one describes the criteria for a successful performance analysis system. Section two identifies the current system and documents it's weaknesses. In section three, we discuss our proposed solution. In the last section, we outline our plan for implementation.

<u>CRITERIA FOR A SUCCESSFUL PERFORMANCE ANALYSIS SYSTEM</u>

Any system which measures the performance of the depot repair process must consider not only what is produced but also what effect production has on mission support. It must identify process problem areas and must provide the capability to do detailed analysis to find solutions. Specifically, any performance analysis system must:

a. Provide an overall picture of the repair process,

b. Identify if AFLC is repairing the right items and in the right quantities,

c. Identify repair process bottlenecks,

d. Provide data at the execution as well as management level so that support actions are consistent with performance goals.

This is the criteria we use to measure the "success" of the current systems and develop a new performance analysis system.

<u>CURRENT SYSTEM</u>

The current method for measuring the performance of the depot repair process is made up of a variety of different performance indicators. They include such things as measures of maintenance efficiency and the level of back orders over time. We will discuss each in turn and then discuss some of their inherent limitations.

First is a measure of maintenance shop efficiency. This is a ratio of the number of "standard hours" provided to maintenance to accomplish the existing workload mix (based upon past history and engineering estimates of the process involved in repairing an item) over the actual number of hours used by maintenance to accomplish the work. A maintenance efficiency ratio is computed:

$$\text{Maintenance Efficiency} = \frac{\text{Standard Number of Hours}}{\text{Actual Number of Hours}}$$

The higher the ratio, the "better" the measure because the number of actual hours used in repair is less that the standard. This measure does not address the mission impact of the items repaired nor does it in any way address process bottlenecks. In fact, the incentive here is to repair large amounts of an item that is relatively easy to repair and where there are plenty of repair parts. There is no guarantee these are the right items or the right quantity to repair. Therefore, it does not meet the criteria for a successful measurement system.

Another current measure is shop flow time. This measure portrays the amount of time that it takes to repair an item on the maintenance shop floor. The lower the shop flow time the "better" the indicator. Again, this measure is really an efficiency oriented measure--it does not relate the impact of the items repaired nor does it identify process bottlenecks. It may show that an item's time in maintenance is increasing but there is no way to tell if this due to a specific reason. It clearly does not meet the criteria outlined.

A third measure is depot repair cycle times. This is the total amount of time that it takes an item to flow into the depot as unserviceable, be repaired, and flow back out of the depot. This is very similar to the measure of shop flow time except that it also considers the time that an item spends in depot supply and the time spent being transported back and forth between supply and maintenance an back and forth between the depot and a base that needs the item. A decrease in repair cycle time is considered to be a positive indicator for the repair process. What this does not consider is the reason for the change. It could be that the workload at the depot has reduced (due to reductions in Depot Purchased Equipment Maintenance or DPEM funds, for example) so maintenance gets to the item faster than normal. If this is a measure of performance we may conclude that the repair process is doing better when in fact the repair process had nothing to do with the reduction in the repair cycle time. This measure clearly does not meet the criteria outlined in the first section of this chapter.

3

The next measure used to assess the performance of the depot repair process is the quantity of production over time. The higher the production count the "better" the repair process. This has no relation to the mission effect of the items repaired and can be influenced by so many things that it is not a good indicator of depot performance. For example, if DPEM dollars force less total repair we would expect this number to decrease. Does this necessarily mean that the performance of the depot repair process is getting worse? We would say NO--the fact that total production decreased would have nothing to do with performance. Therefore, this measure does not meet the criteria described nor does it, in and of itself, provide a good indication of the performance of the depot maintenance facility.

The fifth measure commonly used is the dollar value of awaiting parts incidents. This measure reflects the acquisition cost of the total number of end items not completely repaired because the right component parts were not available. This measure yields little information on the performance of a depot. It may have some reflection on AFLC's parts forecasting techniques but in no way tells us if we are repairing the right items or in the right quantities.

The next measure is investment fill rates. This is a ratio of the number requisitions made for investment items (ones that are repaired) versus the number of these requisitions that were filled. The premise is that if the depot is "doing it's job" then most of these requisitions can be filled--because the items have been repaired and are available for issue. There are so many things influencing this measure (demand rates, total number of assets, new procurement deliveries) that it cannot reflect the performance of the depot. It does not relate the impact of the items repaired and clearly does not meet the criteria outlined above.

The last measure we discuss is the total number of outstanding back orders. A back order is a term for a requisition that cannot be filled because there is not an asset available. This measure is related to the measure of fill rates in that if there are a number of back orders for an item then the fill rate for that item will be low. As such, it is encumbered with the same problems as is the fill rate measure.

In addition to the specific problems with each of these measures, there are some problems associated with the use of any of the indicators discussed. In general, none of the indicators addresses the "real" problem--is AFLC repairing the right items and in the right quantities? Are the items repaired the ones that have the greatest impact on mission support? In addition, all of the indicators use history as the baseline of comparison. There is no direct link to the needs of the field nor the changing requirement associated with changes in aircraft missions over time. As a result of these kind of dynamics, history is not always the proper baseline for performance measurement. Also,

none of these indicators can directly relate the impact of repair on aircraft availability. Furthermore, the use of any of these indicators makes it very difficult to determine process bottlenecks--where are the problem areas and how can they be resolved. Lastly, none of the measures currently used provides useful information at the execution level--management may know that overall production quantities are down but, assuming that this is a problem, there is no information provided that can help to determine a course of action to "fix" the problem. Overall, none of these indicators meets our criteria for a successful performance analysis system and cannot be used, individually or together, to completely measure the performance of the depot level repair process.

PROPOSED SOLUTION

In this section we discuss the approach used to develop our performance analysis system, the benefits of using the system, and the current plans for implementation.

APPROACH

We use a "bottom-up" approach to develop our performance analysis system. We start at the item (national stock number) level and work up. We first identified the most important items to the Air Force based upon their contribution to both peacetime and wartime aircraft availability and show the repair action plan (what is suppose to be repaired) for those items. We then aggregated these action plans across items and compare this to what was actually done over the quarter to determine how well AFLC did. Our proposed system can aggregate item performance by maintenance shop, by division, by air logistics center (ALC), by weapon system, across weapon systems, or across AFLC. We also identify process bottlenecks both at the item and aggregate level. We propose an integration of the New Air Force Critical Item Program (AF CIP) with the Weapon System Management Information System (WSMIS) Repair Categorization Listing (see reference [1]) and with data from the Management of Items Subject to Repair (MISTR) Requirements, Scheduling, and Analysis system (G019C). We propose the development of a series of products which: a.) Shows what action (procurement, modification, and repair) are needed at the item level to make an item "get well" and b.) shows item level data aggregated by weapon system, major command, air logistics center, or across air logistics centers.

PROPOSED PERFORMANCE ANALYSIS SYSTEM

Our solution is a series of five screens that address the performance of both the repair process in total and by individual item. The system has three screens that portray item level data: the Line Item Repair Profile, the Line Item Delivery Profile and the Get Well Game Plan. The last two screens portray aggregate level data: the Aggregate Performance Analysis screen and the Problem Breakout Report. We discuss each in detail.

The Line Item Repair Profile screen (Table 2-1) gives a complete picture of the repair actions associated with each line item. It can be used to identify the current position of the item and to determine the repair action plan for the item and, after the repair quarter has been completed, it can be used to do detailed repair analysis--including assessing the performance of repair at the item level. It is divided into four sections--an Item Description section, a Current Position section, a Get Well Assessment section, and a Repair Performance section.

The Item Description section provides indicative data about the item--the national stock number, the item name, the criticality of the item, etc. This data is provided for identification and information only.

The Current Position section gives more detailed data on the position of the item. This includes the requirement for both peacetime and wartime, the serviceable asset position (both on hand and on order), the unserviceable asset position (split out by condition code), and a "run-down" of the current repair requirement identification process--including the identification of peacetime and wartime repair requirements.

The Get Well Assessment section relates to the criticality of the item. It identifies the item's criticality position in accordance with the New Air Force Critical Item Program (AF CIP). If the item is a critical, potential critical, or problem item it identifies the number of repairs needed to remove the item from the New AF CIP. It also shows the incremental increase in availability that results from repairing the "next" unserviceable asset of that item, and identifies the total cost of repairing this "get well quantity" (constrained to what we are capable of producing) broken down to Mission Design Series (MDS).

The last section of this screen is the Repair Performance section. This portion identifies the repair action plan for the coming quarter and any portion of the requirement that was not negotiated (along with reason codes). Also shown are any changes that occur over the quarter including negotiation changes and reasons for the changes. Last, the actual production level is shown and the level of performance is assessed for each item. To do this, the system compares three things: 1.) the scrubbed requirement against the negotiation quantity to show if AFLC plans to produce the requirement, 2.) the get well quantity (constrained by what we are capable of producing) against the negotiation quantity to show if AFLC plans to produce enough to "get well", and 3.) the total produced against the negotiated quantity to show if AFLC produced what had been planned.

FY 88-2
LINE ITEM REPAIR PROFILE

```
--------------------------------------------------------------------------------------------
:                             INDICATIVE DATA                         RANK                  :
:                                                                      BY                   :
:   NSN          NOUN        MDS      MAJCOM    SOS   SOR   IMS   CRITICAL HURDLE   W/S   UNIT REPAIR COST :
:xxxxxxxxxxxxxx  xxxxxxxxx  xxxxxx   xxxxxx    xx    xxx   xxx   xxxxxxxxxxxxxx    xxxx      xxxxxxx.xx    :
--------------------------------------------------------------------------------------------
```

```
---------------------------------------------------------------------      -----------------------
:                              CURRENT POSITION                      :  : :   GET WELL ASSESSMENT  :
:                                                                    :  : :-----------------------:
:                                                QTRLY SNAPSHOT OF   :  : :                       :
:    REQUIREMENT         SERVICEABLES       UNSERVICEABLES    CURRENT POSITION :  : :     MARGINAL GAIN     :
:      POS- xxxxx        BASE POS- xxxx       COND D- xxxx   AF GROSS RQMT- xxxxxx :  : :      A/C DEFICIT- xxxx :
:      WRM- xxxxx        BASE WRM- xxxx       COND F- xxxx   SERVICEABLES- xxxxxx  : :GET WELL REPAIR RMT- xxxx:
:  AF GROSS- xxxxx          DEPOT- xxxx       COND G- xxxx    BASE REPAIR- xxxxxx  : :A/C INCREASE/REPAIR- xxxx:
:                   PHASED DUE-IN- xxxx       COND J- xxxx      2ND SHORT- xxxxxx  : :    UNIT REPAIR COST- xxxx:
:                           TOTAL- xxxx       COND M- xxxx   AVAIL DEP REP- xxxxxx : :GET WELL COST-MDS 1- xxxx :
:                                           INTRANSIT- xxxx   POS MISTR OUT- xxxxxx: :GET WELL COST-MDS 2- xxxx :
:                                       EXPECTED GENS- xxxx   WRM MISTR OUT- xxxxxx: :GET WELL COST-TOTAL- xxxx :
:                                               TOTAL- xxxx                        : :-----------------------:
---------------------------------------------------------------------
```

```
-----------------------------------------------------
:                 REPAIR PERFORMANCE                 :
:                                                    :
:   REPAIR ACTION PLAN      REPAIR PERFORMANCE MEASURE :
:D073 SCRUB RQMT- xxxxxx      SCRUB RQT vs NEG QTY- xx :
:NEGOTIATION QTY- xxxxxx    GET WELL RT vs NEG QTY- xx :
:  FINAL NEG QTY- xxxxxx      PRODUCED vs NEG QTY- xx  :
: AVAILABLE REPS- xxxxxx     BEGINNING NEG CODE- xx    :
: TOTAL PRODUCED- xxxxxx     RE-NEGOTIATION CODE- xx   :
:                           PRODUCTION DEF CODE- xx    :
-----------------------------------------------------
```

TABLE 2-1

The second screen is the Line Item Delivery Profile. This screen (Table 2-2) is designed to give the user data on the other ways (other than repair) of meeting an item's requirement. It has three sections.

The first is the same as with the Line Item Delivery Profile--an indicative data section identifying the item and the criticality category--critical, potential critical, or problem.

The second section is the On Order and Contract Delivery Schedule. It is identified to give the user information on the other ways that are being used to satisfy the requirement. New procurement and contract repair in many cases are being used to satisfy portions of an item's requirement and this is identified so that item detailed repair analysis can be completed. This section shows the number of assets that are on order (both purchase request funded and on contract) for both Peacetime Operating Stock (POS) and War Reserve Material (WRM). Also shown is the phased delivery schedule for these items. In addition, the number of assets sent to the contractor for repair and their phased delivery schedule are identified.

The third section of this screen is the Reliability and Maintainability section. This section identifies the mean time between demand (MTBD) and the total organizational and intermediate maintenance demand rate (TOIMDR) for the item. In addition, it shows the modification schedule for the item--if it is being modified.

LINE ITEM DELIVERY PROFILE

INDICATIVE DATA									
NSN	NAME	W/S	MAJCOM	ALC	SOR	IMS	CRITICAL HURDLE	RANK	UNIT REPAIR COST
xxxxxxxxxxxxxx	xxxxxxxxx	xxxxxx	xxxxxx	xx	xxx	xxx	xxxxxxxxxxxxxxx	xxxx	xxxxxxx.xx

---

ON ORDER AND CONTRACT REPAIR DELIVERY SCHEDULE

QUANTITY OF ON-ORDER ASSETS

PR FUNDED- xxxxx
ON CONTRACT- xxxxx
WRM PR FUNDED- xxxxx
WRM ON CONTRACT- xxxxx
TOTAL- xxxxx

DELIVERY SCHEDULE

xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx
Sep87	Dec87	Mar88	Jun88	Sep88	Dec88	Mar89	Jun89

CONTRACTOR REPAIR DELIVERY SCHEDULE

xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx
Sep85	Dec85	Mar86	Jun86	Sep86	Dec86	Mar87	Jun87

RELIABILITY AND MAINTAINABILITY DATA

RELIABILITY HISTORY-MTBD OVER LAST 8 QUARTERS

xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx
Sep85	Dec85	Mar86	Jun86	Sep86	Dec86	Mar87	Jun87

TOTAL OIM DEMAND RATE-CURRENT PLUS 3 FORECASTS

xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
Sep 87	Dec 87	Mar 88	Jun 88

MODIFICATION SCHEDULE

xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx
Sep85	Dec85	Mar86	Jun86	Sep86	Dec86	Mar87	Jun87

TABLE 2-2

The third screen (Table 2-3) is the Get Well Game Plan. This screen is a graphic portrayal of all means being used to satisfy the requirement for an item. It shows the total requirement by quarter and what is being done to meet this requirement through the use of serviceable assets, new procurement, modification, organic repair and contract repair. If the item is not "well" then this screen will also identify the requirement deficit i.e., that portion of the requirement that cannot be met. Lastly, the get well date is shown in two ways-- as a statement of the get well date and graphically at the point where there is no longer a requirement deficit.

11

TOTAL REQUIREMENT

```
:
:
:                                                                 -----   -----
:                                                                 :RPC:   :RPC:
:                                                 -----   -----   :---:   :---:
:                                         -----   !!!!!   :RPC:   :   :   :   :
:                                 -----   !!!!!   :UR!:   :---:   :   :   :   :
:                         -----   !!!!!   !!!!!   :UR!:   !!!!!   :   :   :   :
:                         !!!!!   :UR!:   :UR!:   !!!!!   :---:   :RPO:   :RPO:   :RPO:
:                 -----   !!!!!   !!!!!   !!!!!   :---:   :RPC:   :   :   :   :   :   :
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:         !!!!!   !!!!!   :---:   :---:   :RPO:   :---:   :   :   :---:   :---:
: -----   :UR!:   :---:   :RPO:   :RPO:   :---:   :   :   :   :   :   :   :   :
: !!!!!   !!!!!   :RPC:   :---:   :---:   :MD :   :MD :   :MD :   :   :   :   :
: :UR!:   :---:   :---:   :MD :   :MD :   :---:   :---:   :---:   :   :   :   :
: !!!!!   :RPC:   :RPO:   :---:   :---:   :   :   :   :   :   :   :   :   :   :
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: :RPC:   :RPO:   :   :   :   :   :NP :   :---:   :---:   :---:   :SA :   :SA :
: :---:   :---:   :NP :   :NP :   :---:   :   :   :   :   :   :   :   :   :   :
: :RPO:   :NP :   :---:   :---:   :   :   :   :   :   :   :   :   :   :   :   :
: :---:   :---:   :   :   :   :   :SA :   :SA :   :SA :   :SA :   :   :   :   :
: :SA :   :SA :   :SA :   :SA :   :   :   :   :   :   :   :   :   :   :   :   :
-----------------------------------------------------------------------------------
   :        :        :        :        :        :        :        :        :        :
 Sep87    Dec87    Mar88    Jun88    Sep88    Dec88    Mar89    Jun89    Sep89    Dec89
```

(Actual) (----------------------------Forecast----------------------------------)

TIME BY QUARTER

KEY
```
    SA-Serviceable Assets
    NP-New Procurement
    MD-Modification
    RPO-Organic Repair Quantity
    RPC-Contract Repair Quantity
    -----
    !!!!!
    :UR!:-Unfilled Rqmt
    !!!!!
    -----
```

TABLE 2-3

The forth screen is the Aggregate Level Performance Analysis screen. This screen (Table 2-4) reflects the repair performance for any selected set of items. This screen aggregates elements from the item level and portrays the totals categorized by the criticality of the items selected. The report is broken into four categories: critical items, potential critical items, problem items and non-problem items. This grouping is based on the New Air Force Critical Item Program (AF CIP) categorization of items. The New AF CIP is a program designed to pro-actively identify the items who's current asset position is causing the greatest negative impact on peacetime aircraft availability and wartime capability. The criteria includes such things as Mission Capable (MICAP) incidents, Awaiting Parts (AWP) incidents, and an estimate of the number of Fully Mission Capable (FMC) aircraft at the 30 day point in the war. Each major command (MAJCOM) has helped construct criteria that is tailored to their individual needs. If an item is not in the New AF CIP it is considered a non-problem item and is relegated to a forth or non-problem category.

W/S OR ALC OR COMMAND LEVEL

REPAIR PERFORMANCE MEASUREMENT

CATEGORY	D041 REPAIR RQMT (1)	TOTAL SCRUB RQMT (2)	GET WELL RQMT (3)	TOTAL NEG QTY (4)	TOTAL PRODUCED (5)	SCRUB QY vs NEGOT QY (4/2)	GET WELL vs NEGOT QY (4/3)	PRODUCT vs NEGOT QY (4/5)
CRITICAL	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXX	XX	XX	XX
POTENTIAL CRITICAL	XXXXXX	XXXXXX	XXXXX	XXXXX	XXXXX	XX	XX	XX
PROBLEM	XXXXXX	XXXXXX	XXXXX	XXXXX	XXXXX	XX	XX	XX
NON-PROB	XXXXX	XXXXXX	XXXXX	XXXXX	XXXXX	XX	XX	XX

PERCENT OF ITEMS BY CATEGORY: CRITICAL- XX
POTENTIAL CRITICAL- XX
PROBLEM- XX
NON-PROBLEM- XX

TABLE 2-4

This categorization helps determine if AFLC is repairing the right items-items that are classified as critical should have better repair performance (either more repair in total or most repair possible given asset and parts constraints) than items that are in the non-problem category. This screen also shows if AFLC is repairing the right quantity of items. Here is how we define repair performance. Compare the total repair requirement to what is negotiated for repair and what is actually produced. We first identify the total scrubbed repair requirement, which is AFLC's best estimate of what repair will be needed over the quarter. Next we identify the total get well quantity, i.e., that portion of the total repair requirement needed to "get out" of the AF CIP--while constrained to what we are capable of producing. We then identify the total negotiated requirement and the total produced. We show the level of repair performance for each item and aggregated by critical item category. We compare the total scrubbed requirement against the total negotiated quantity--to determine if AFLC "plans" on producing the requirement. Next, we compare the total get well requirement with the total negotiated quantity--to show if AFLC "plans" on producing at least the get well requirement. Last, we compare the total negotiated quantity with the total produced to see if AFLC produced what was "planned".

The last screen is the Problem Breakout Report. The Problem Breakout Report (Table 2-6) is the screen that identifies the repair process bottlenecks that are negatively impacting AFLC's ability to repair the right items in the right quantities. This screen categorizes the items into critical, potential critical, problem, and non-problem just as the Aggregate Performance Analysis screen does. It groups items based on their relative impact on peacetime and wartime support. The report then identifies three sets of codes: 1.) Negotiation codes, 2.) Re-Negotiation codes, and 3.) Production Deficit codes.

The Negotiation codes attempt to show reasons that the total scrubbed requirement was not negotiated. This will help determine if there is a known limiting factor to the accomplishment of the stated repair requirement. The eight codes can be found in Table 2-5.

NEGOTIATION CODES

CODE	EXPLANATION
A-Tech Data	Insufficient or incorrect technical data reduces capability
B-Equipment	Support Equipment problem reduces repair capability
D-Capacity	Insufficient capacity in maintenance to repair requirement
E-Software	Insufficient maintenance software to repair the requirement
F-Funds	Insufficient repair dollars available to repair requirement
K-Carryover	Incomplete quantities from last quarter reducing capacity
N-Parts	Insufficient component parts available to repair requirement
O-Assets	Insufficient assets available to repair the requirement

TABLE 2-5

TABLE 2-6--W/S OR ALC OR COMMAND LEVEL PROBLEM BREAKOUT REPORT

CATEGORY	UNDERNEGOTIATION- SCRUB vs NEG QTY	RE-NEGOTIATION- BEG vs END NEG	PRODUCTION DEFICIT - NEG QTY vs PROD
CRITICAL	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX% R (Rqmt Change)- XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Higher Priority Workload) - XX% E (Software Not Available) - XX% N (Parts Not Available) - XX% O (Assets Not Available) - XX% R (Revised Equipment) - XX% Z (Error) - XX%
POTENTIAL CRITICAL	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX% R (Rqmt Change)- XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Higher Priority Workload) - XX% E (Software Not Available) - XX% N (Parts Not Available) - XX% O (Assets Not Available) - XX% R (Revised Equipment) - XX% Z (Error) - XX%
PROBLEM	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX% R (Rqmt Change)- XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Higher Priority Workload) - XX% E (Software Not Available) - XX% N (Parts Not Available) - XX% O (Assets Not Available) - XX% R (Revised Equipment) - XX% Z (Error) - XX%
NON-PROB	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX% R (Rqmt Change)- XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Higher Priority Workload) - XX% E (Software Not Available) - XX% N (Parts Not Available) - XX% O (Assets Not Available) - XX% R (Revised Equipment) - XX% Z (Error) - XX%
TOTAL ACROSS CATEGORIES	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Capacity) - XX% E (Software) - XX% F (Funds) - XX% K (Carryover) - XX% N (Parts) - XX% O (Assets) - XX% R (Rqmt Change)- XX%	A (Tech Data) - XX% B (Equipment) - XX% D (Higher Priority Workload) - XX% E (Software Not Available) - XX% N (Parts Not Available) - XX% O (Assets Not Available) - XX% R (Revised Equipment) - XX% Z (Error) - XX%

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The next set of codes identified are the Re-Negotiation codes. These codes are used to show problems that occur during the repair quarter. It is not something that was expected as with the Negotiation codes. These codes identify problems that occur as the quarter progresses that force a reduction in the amount of repair planned to be accomplished versus what had originally been planned. These codes can be found in Table 2-7.

RE-NEGOTIATION CODES

CODE	EXPLANATION
A-Tech Data	Insufficient or incorrect technical data reduces capability
B-Equipment	Support Equipment problem reduces repair capability
D-Capacity	Insufficient capacity in maintenance to repair requirement
E-Software	Insufficient maintenance software to repair the requirement
F-Funds	Insufficient repair dollars available to repair requirement
K-Carryover	Incomplete quantities from last quarter reducing capacity
N-Parts	Insufficient component parts available to repair requirement
O-Assets	Insufficient assets available to repair the requirement
R-Rqmt	A requirement change caused a change in the need for repair

TABLE 2-7

The last set of codes used are the Production Deficit codes. These codes attempt to document reasons why, even with re-negotiation, the negotiation quantity was not produced. These codes can be found in Table 2-8.

PRODUCTION DEFICIT CODES

CODE	EXPLANATION
A-Tech data	Insufficient or incorrect technical data reduced capability
B-Equipment	Support Equipment problem reduced repair capability
D-Workload	Higher priority workload made this repair not possible
E-Softwar	Insufficient maintenance software to repair negotiated qty
N-Parts	Insufficient component parts to repair negotiated quantity
O-Assets	Insufficient assets available to repair the negotiated qty
R-Rqmt	A requirement change caused a change in the need for repair
Z-Error	Error category

TABLE 2-8

It is important to remember that the point of this report is to identify process bottlenecks so that solutions to the problems can be found. The use of the codes identified above identifies problem areas at three points in repair process; at the aggregate level and by category of item. This highlights the problem areas so that AFLC can do detailed analysis of the problems identified so that solutions can be found. In addition, if solutions cannot be found or implemented (due to prohibitive cost, for example) then this screen can be used to explain the level of performance in a certain category or across categories.

SUMMARY

Our system of five screens meets all of our criteria for a successful performance analysis system. It provides an overall picture of the repair process and identifies if AFLC is repairing the right items in the right quantities through the use of the Aggregate Level Performance Analysis screen. In also identifies process bottlenecks through the use of the Problem Breakout Report. Lastly, it provides data at the execution (item) and management (aggregate) levels so that support actions are consistent with performance goals.

We believe that the system developed can be used by all Item Management Specialists (IMS), Production Management Specialists (PMS), and management levels. Item Management personnel can use the Line Item products to do detailed repair analysis for items with repair problems. In addition, IM personnel can use the aggregate level screens for reviewing the performance for his/her group of items. Production Management personnel can use the products for many of the same reasons--they can review the performance of and process bottlenecks for "their" set of items. All levels of management can use the aggregate level screens for

reviewing the performance at different levels of aggregation--
section chiefs can review his/her section's items and an ALC
commander can review his total ALCs performance over a given
quarter. Our system is designed with flexibility in mind--the
user can "slice and dice" data in different ways depending on
his/her perspective.

IMPLEMENTATION

We have identified the need to program our proposed Repair
Process Performance Measurement system to the Weapon System
Management Information System (WSMIS) System Program Office
(SPO). They will develope this system as part of the Get Well
Assessment Module (GWAM). It will be integrated with the "WSMIS
Repair Categorization Listing" [1] because the Categorization
Listing and the Line Item Repair Profile have much of the same
data. We have prioritized the various parts of our proposal for
implementation. Table 2-9 outlines our implementation strategy.

SYSTEM IMPLEMENTATION

PHASE	IMPLEMENTATION ACTION	ECD
1	Development of the Line Item Repair Profile and Aggregate Level Performance Analysis screens	1 Oct 88
2	Development of the Problem Breakout Report	1 Jan 89
3	Development of the Line Item Delivery Profile and the Get Well Game Plan screens	1 Jan 89

TABLE 2-9

This phased development and implementation strategy allows for a
return on investment in the near-term. AFLC can begin to measure
depot repair performance and to do detailed repair analysis
before the complete system is operational. The Analytical
Sciences Corporation (TASC) is developing this system in
WSMIS/GWAM according to the specifications outlined in this
report (see Appendix A for a description of the data elements in
our proposed system).

CHAPTER 3
CONCLUSIONS AND RECOMMENDATIONS

<u>CONCLUSIONS</u>
1. Currently, there is no consistent, accepted method for measuring the overall performance of the depot level exchangeable repair process.

2. The current system of measuring the various parts of the performance of the depot level exchangeable repair process does not meet our criteria for a successful performance measurement system.

3. The New Air Force Critical Item Program categorizes items as critical, potential critical, and problem based on Air Force-wide accepted criteria, which identifies an item's impact on peacetime and wartime weapon system availability.

4. The proposed Repair Process Performance Analysis system:

   a. Identifies repair performance by category of items; critical, potential critical, problem, and non-problem.

   b. Compares the actual repair performance to the planned repair (negotiation quantity) and the repair requirement.

   c. Identifies process bottlenecks so that solutions can be found.

   d. Measures the performance of the overall exchangeable repair process.

   e. Provides the necessary data at the execution level to ensure support actions are consistent with performance goals.

5. The WSMIS system has the data base and the programming capability to develop the performance analysis system.

<u>RECOMMENDATIONS</u>
1. Develop, in the WSMIS/GWAM module, the Repair Process Performance Analysis system.   (OPR:LMSC/SMWW   OCR:HQ AFLC/MMM)

2. Use the Repair Process Performance Analysis system to measure the performance of the depot level exchangeable repair process. (OPR:HQ AFLC/MM/MA)

APPENDIX A-DATA ELEMENT DESCRIPTION

This Appendix describes the data abbreviation and the data
sources for the data elements needed in our proposed performance
analysis system. In addition, it provides the algorithms used
and the the source data. We include this appendix to assist the
WSMIS contractor in developing on performance analysis system.

DATA ELEMENT	ABBREVIATION	DATA SOURCE
Actual National Stock Number	NSN	D165A
Item Nomenclature	Name	D041
Mission Design Series	MDS	WSMIS/SAM
Major Command	MAJCOM	WSMIS/SAM
Source of Supply	SOS	D041
Source of Repair	SOR	G072D
Inventory Management Specialist	IMS	D041
Critical Hurdle	Critical Hurdle	WSMIS/GWAM
Item Rank For This Weapon System	Item Rank	WSMIS/GWAM
Unit Repair Cost	Unit Repair Cost	D041
Peacetime Operating Requirement	POS	D041
War Reserve Materiel Rqmt	WRM	D041
Air Force Total Gross Requirement	AF Gross	D041
Serviceable Peacetime Assets, Base	Base POS	D041
Serviceable Wartime Assets, Base	Base WRM	D041
Serviceable Assets At Depot Level	Depot	D041
Assets Due In From Procurement	Phased Due-Ins	D041
Unserviceable, On-Hand	On-Hand	D041
Unserviceable, Intransit To Depot	Intransit	D041
Unserviceable, Reparable Generations	Expected Gens	D041
Unserviceable, Total	Total	D041
Air Force Total Gross Requirement	Rqmt	D041
Total Number of Serviceable Assets	Serviceables	D041
Total Quantity of Base Repair	Base Repair	D041
D041 Second Short Position	2ND Short	D041
Total Number of Unserviceable Assets	Avail Dep Rp	D041
Total Peacetime Repair Requirement	POS MISTR Rt	D041
Total Wartime Repair Requirement	WRM MISTR Rt	D041
Get Well Aircraft Deficit	A/C Deficit	SEE ALGORITHM SECTION
Repair Needed to Achieve Get Well	Get Well Rep Rt	SEE ALGORITHM SECTION
Potential NMCS Reduction Per Repair	A/C Increase/Repair	SEE ALGORITHM SECTION
Get Well Repair Cost, First MDS	Get Well Cost, MDS1	SEE ALGORITHM SECTION
Get Well Repair Cost, Next MDS	Get Well Cost, MDS2	SEE ALGORITHM SECTION
Total Cost of Get Well Repair	Total Get Well Cost	SEE ALGORITHM SECTION
D073 Scrubbed Requirement	Scrub Rqmt	D073
Beginning Negotiation Quantity	Negotiation Qty	G019C
Final Negotiation Quantity	Final Neg Qty	G019C
Total Number of Unserviceable Asset	Avail Dep Rp	D041
Quantity Produced	Total Produced	G019C

DATA ELEMENT	ABBREVIATION	DATA SOURCE
Repair Performance--Rqmt	Rqmt Def vs Neg Qty	SEE ALGORITHM SECTION
Repair Performance--Get Well	C-1 Rqmt vs Neg Qty	SEE ALGORITHM SECTION
Repair Performance--Production	Produced vs Neg Qty	SEE ALGORITHM SECTION
Beginning Negotiation Code	Beginning Neg Code	G019C
Re-Negotiation Code	Re-Negotiation Code	G019C
Production Deficit Code	Production Def Code	G019C
Order, Purchase Request Funded	PR Funded	D041
On-Order, On Contract	On Contract	D041
On-Order, War Reserve Materiel PR Fund	WRM PR Funded	D041
On-Order, WRM On Contract	WRM On Contract	D041
On-Order, Total	Total	D041
Total OIM Demand Rate	Total OIM Dmd Rate	D041
Mean Time Between Demand, 8 Quarters	MTBD, Last 8 Qtrs	OC-ALC LMDB
Procurement Delivery Schedule	Delivery Schedule	OC-ALC LMDB or D041
Modification Schedule	Mod Schedule	G079
Contract Repair Delivery Schedule	(same)	G072D
Outyear Serviceable Asset Position	SA	D041
Outyear New Procurement Deliveries	NP	D041
Outyear Modification Deliveries	MOD	G079
Outyear Organic Repair Quantities	RPO	D041
Outyear Contract Repair Quantities	RPC	G072D
Outyear Unfilled Total Requirement	UR	SEE ALGORITHM SECTION
Total Air Force Gross Requirement	Total Gross Rqmt	D041
Total Requirement Deficit	Total Rqmt Deficit	SEE ALGORITHM SECTION
Total Get Well Requirement Deficit	Get Well Rqmt Deft	SEE ALGORITHM SECTION
Total D073 Scrubbed Requirement	Total Scrub Rqmt	D073
Total Negotiation Quantity	Total Neg Quantity	G019C and G072D
Total Quantity Produced	Total Produced	G019C
Total Repair Performance--Rqmt	Rqmt Def vs Neg Qty	SEE ALGORITHM SECTION
Total Repair Performance--Get Well	Get Well vs Neg Qty	SEE ALGORITHM SECTION
Total Repair Performance--Production	Produced vs Neg Qty	SEE ALGORITHM SECTION
Total Beginning Negotiation Codes	Beginning Neg Code	SEE ALGORITHM SECTION
Total Re-Negotiation Codes	Reneg Codes	SEE ALGORITHM SECTION
Total Production Deficit Codes	Prod Codes	SEE ALGORITHM SECTION
Percent of Items by Category	Percent by Cat	SEE ALGORITHM SECTION
Percent of Items Achieving C-Status	Percent C-Stat	SEE ALGORITHM SECTION

Reasons For Undernegotiation	(same)	SEE ALGORITHM SECTION
Reasons For Re-Negotiation	(same)	SEE ALGORITHM SECTION
Reasons For Underproduction	(same)	SEE ALGORITHM SECTION

ALGORITHM SECTION

DATA ELEMENT AND EQUATION

Total Outstanding Requirement = Initial D041 Rqmt - (Total Serv Ast + Base Repair) (Note--This should equal the D041 Second Short)

Get Well Aircraft Deficit = ((A/C For Get Well) - (PAA - Total NMCS) where Total NMCS = Total Not Mission Capable Status from WSMIS/SAM and n = the number of MDSs.

Repair Needed to Get Well = ((Smallest Integer k Such That (k >= (Get Well Aircraft Deficit * EBO per NMCS A/C))) where k = Repairs Needed, EBO = Expected Backorders from WSMIS/SAM, NMCS A/C = Not Mission Capable Status Aircraft from WSMIS/SAM and n = the number of MDSs.

Potential NMCS Reduction Per Repair = ((NMCS/EBO)/n where NMCS = Not Mission Capable Status from WSMIS/SAM, EBO = Expected Backorders from WSMIS/SAM and n = the number of MDSs.

Get Well Total Repair Cost, First MDS = (Smallest Integer k Such That (k >= (Get Well Aircraft Deficit * EBO per NMCS A/C)) * URC) where k = Repairs Needed, EBO = Expected Backorders from WSMIS/SAM, NMCS A/C = Not Mission Capable Status Aircraft from WSMIS/SAM and URC = Unit Repair Cost from D041.

Get Well Total Repair Cost, Next MDS = (Smallest Integer k Such That (k >= (Get Well Aircraft Deficit * EBO per NMCS A/C)) * URC) where k = Repairs Needed, EBO = Expected Backorders from WSMIS/SAM, NMCS A/C = Not Mission Capable Status Aircraft from WSMIS/SAM and URC = Unit Repair Cost from D041.

Total Cost of Get Well Repair = (Get Well Total Repair Cost, by MDS where each "Get Well Total Repair Cost" by MDS is computed above.

Repair Performance--Rqmt = (Negotiation Qty/D073 Scrubbed Rqmt) * 100 where Negotiation Qty = Beginning Negotiation Quantity from G019C and the D073 Scrubbed Rqmt = D073 IMS Scrubbed Requirement from D073.

Repair Performance--Get Well = (Negotiation Qty/Get Well) * 100 where Negotiation Qty = the Beginning Negotiation Quantity from G019C and the Get Well Rqmt = the "Repair Needed to Achieve Get Well Status" computed above.

Repair Performance--Production = (Negotiation Qty/Actual Production) * 100 where Negotiation Qty = Beginning Negotiation Quantity from G019C and Actual Production = Actual Production from G019C.

Outyear Unfilled Total Requirement = Total Air Force Gross Requirement - ("Outyear Serviceable Assets" + "Outyear New Procurement Deliveries" + "Outyear Organic Repair Quantities" + "Outyear Contract Repair Quantities") where all variables in this equation are defined above.

Total Requirement Deficit = (("Total Outstanding Requirement") where n = the number of NSNs in each category and the "Total Outstanding Requirement" from above.

Total Get Well Requirement Deficit = (("Repair Needed to Achieve Get Well Status") where n = the number of NSNs in each category and the "Repair Needed to Achieve Get Well Status" is computed above.

Total Repair Performance--Rqmt = ((Negotiation Qty/(D073 Scrubbed Rqmt) * 100 where Negotiation Qty = Beginning Negotiation Quantity from G019C, the D073 Scrubbed Rqmt = D073 IMS Scrubbed Requirement from D073, and n = the number of NSNs in each category.

Total Repair Performance--Get Well = ((Negotiation Qty/(Get Well Rqmt) * 100 where Negotiation Qty = the Beginning Negotiation Quantity from G019C, the Get Well Rqmt = the "Repair Needed to Achieve Get Well Status" computed above, and n = the number of NSNs in each category.

Total Repair Performance--Production = ((Negotiation Qty/(Actual Production) * 100 where Negotiation Qty = Beginning Negotiation Quantity from G019C, Actual Production = Actual Production from G019C, and n = the number of NSNs in each category.

Percent of Items by Category = (Number of NSNs in Each Category/ (((Number of NSNs in Each Category) * 100 where n = the number of NSNs in each category and m = the number of categories (4).

Reasons For Undernegotiation = ((Number of NSNs With Each Reason Code/(Total Number of NSNs in Each Category) * 100 where each reason code can be found in the G019C system. Reasons For Re-Negotiation = ((Number of NSNs With Each Reason Code/(Total Number of NSNs in Each Category) * 100 where each reason code can be found in the G019C system.

Reasons For Underproduction = ((Number of NSNs With Each Reason Code/(Total Number of NSNs in Each Category) * 100 where each reason code can be found in the G019C system.